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AUTHOR Lundberg, Ingvar; Rosen, Monica
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ABSTRACT

A study examined issues related to between- and within-class decomposition of variance in reading achievement. The aim is to find "pure" latent structures of achievement at the between-class level as a basis for further investigation of explanatory factors such as teaching. Multilevel factor analysis (MFA) can give a pattern corresponding to an analysis with perfectly reliable scores. Data were taken from the IEA Study of Reading Literacy which involved 200,000 students from 30 different countries. Narrative texts for 9-year-olds were the focus of the multilevel factor analysis. MFA analysis was based on 39 variables, of which 23 were document items and 16 narrative/expository item parcels. LISREL models were fitted separately for between and within levels. The models were then pieced together into one complete MFA model. Findings demonstrate how a global skill like reading can be decomposed not only into individually based factors but also into factors related to group belongingness where differential influences of schooling conditions and home background could be discerned by reference to demand characteristics of small subsets of individual items. (Contains 19 references, 5 tables of data, and a figure presenting 2 subtests from the document domain.) (RS)

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Two-level Structural Modeling of Reading Achievement as a Basis for Evaluating Teaching Effects

Ingvar Lundberg & Monica Rosén

Göteborg university, Sweden

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Address: Department of Psychology
Göteborg university
Haraldsgatan 1
S-413 14 Göteborg, Sweden

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Two-level Structural Modeling of Reading Achievement as a Basis for Evaluating Teaching Effects.

Ingvar Lundberg & Monica Rosén

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This article studies issues related to between- and within-class decomposition of variance in reading achievement. The aim is to find "pure" latent structures of achievement at the between-class level as a basis for further investigation of explanatory factors (like, for example, teaching). Muthén (1991) has demonstrated that measurement errors have seriously distorting effects on the variance decomposition. A multilevel factor analysis, however, gives a pattern corresponding to an analysis with perfectly reliable scores. An illustrative example of this approach will be given in the present paper.

There are a number of possible reasons for classroom variations in achievement. In societies with marked social stratification one would expect considerable variation beetween classrooms as the student composition covaries with the socio-economic level of the neighborhoods from which the school enrollment is made. Another factor, closely associated with the SES-levels of the students´ families, is the variation in the cultural resources of the communities where the classrooms are located. In communities with libraries, theaters, book stores, richness of environmental print, access to secondary education, universities etc., one would expect a richer stimulation and stronger pressure for literacy growth as compared to what is the case in less resourceful communities. A third source of between variation is the resources available in school, such as materials, school library, literacy culture and tradition, leadership etc. The

fourth factor, of particular concern in our studies planned to follow the groundwork to be presented here, is related to variation in teaching conditions, teacher characteristics and instructional practices.

Earlier attempts to demonstrate the influence of instructional variables on reading achievement have not been very successful (Lundberg, & Linnakylä, 1992; Munck & Lundberg, 1994). There are at least two related reasons for this state of affairs. The first is related to the nature of reading and the process of reading acquisition. Reading might be less dependent on formal instruction than what is traditionally assumed. The second circumstance is more a methodological concern related to the problem of discovering weak signals of teaching effects against a background of strong between-student factors (individual aptitude and home background). Before we go deeper into the methodological issue and present some results as illustration, we will briefly discuss the nature of reading and its development.

Reading instruction

Reading is certainly not a naturally evolved skill like walking or talking, but instead a skill which is a product of cultural evolution relying on cultural transmission for its continued existence. In other words, reading is primarily a cultural practice (for a further discussion, see Lundberg & Høien, 1991) This perspective provides a challenge to researchers of comparing reading achievement and reading instruction in different countries and cultures.

Successful reading instruction appears to many people to be a key factor in education. From the current debate on methods of instruction in the early grades, it seems as if the most crucial factor in the acquisition process is related to teaching method such as phonics or a meaning-based approach. Yet, a major finding from program comparison studies is the great variation in effectiveness within any particular instructional method (see Adams, 1990). It is highly unlikely that a universally best method for teaching reading can be defined. The effectiveness of a method depends too much on the details of its realizations, its materials, its teachers, its students, its cultural context and the compatibility of each with the other (Lundberg & Linnakylä, 1992).

Formal instruction in school is not even necessarily a prerequisite for the acquisition of a complex skill such as reading. There are other arenas

than school settings for literacy development as is seen in the increasing number of children who enter school at a fairly advanced stage of reading and writing proficiency, a skill which is further cultivated by voluntary reading activities outside school (Dickinson, 1994)..

A child who is exposed to half an hour story book reading per day over the preschool years together with informal experience with toy letters, computer games, road signs, playful writing, postcards from grandmother, encouragement to learn the names of letters etc. will enter the first grade with thousands of hours of active involvement in text and print. This child has certainly also experienced and understood the joy of reading and its potential value in life.

Other children may have a very limited amount of exposure to print and very few opportunities to interact with text under the supervision of encouraging and interested adults. In fact, such initial differences between children even tend to increase over the years in a snowballing process known as the Matthew effect in educational development (Stanovich, 1986). It is certainly a hard task for teachers to make up for such differences. And for the researcher on learning and instruction, it might be a hard task to discover strong signals of teaching effects in the field of reading.

The IEA study

The IEA Study of Reading Literacy (Elley, 1994) provided a unique opportunity to investigate how reading achievement varies and how reading is taught in a large number of education systems with wide variations in traditions, economic development, school organizations, classroom conditions, teacher characteristics, orthography etc. The study was based on data from about 30 different countries where reading achievement was assessed in representative and comparable samples of 9-year-olds and 14-year-olds. A total of about 200 000 students participated, and more than 10 000 teachers filled in detailed questionnaires concerning their instructional practices and educational attitudes or value positions, their explicit and implicit theories of reading instruction and their views of how the acquisition of reading skills takes place.

The wide spectrum of teaching conditions and instructional practices in an international study of this kind might make it possible to detect signals of teaching practices that have an influence on students´ reading

achievement over and above what is explained by home factors and community resources (Lundberg & Linnakylä, 1992; Munck & Lundberg, 1994).

Since a main concern here is to establish latent achievement factors at the classroom level, we will give some additional comments on the nature of reading and its decomposition, before we look closer at the procedures for assessing reading achievement within the IEA study

The nature of reading

Reading seems to be a far more complex skill than was envisioned earlier. Since the 1970 years, reading research, within the context of cognitive psychology, has provided a rich and complex view of reading where the interactive and constructive nature has been emphasized (Lundberg, 1991). The prior knowledge that the students bring to the reading task and the cognitive strategies they use to monitor and maintain their understanding play important roles in the reading process (see e.g. Baker & Brown, 1984). Thus, the reader is regarded as an active individual, a participant who constructs meaning through the integration of existing knowledge and new knowledge from the text.

A strong version of this view of reading implies that there is no such thing as a general reading ability which is applicable to a wide variety of text types and reading situation. Reading is rather a kind of situated cognition where the specific context and the specific purpose of a given reading task define the cognitive process involved (see, e.g., Goodman, 1986). This implies that reading is not a skill that can be measured or assessed by conventional procedures, such as passages followed by multiple-choice questions.

However, as the work of Kintsch (1988) and others illustrates, theory is drifting back and being tempered by a consideration of how the external stimulus (the text structure) constrains comprehension. This new text-based orientation tends to deemphasize the role of prior knowledge. Reading is then regarded more as a linguistic skill than as a context-bound cognitive activity. Syntactic analysis, propositional encoding, sentence comprehension, and intersentence integration are processes in focus.

Components of reading

The first obvious component of reading is that the printed words are recognized (decoded) and give access to the reader´s mental lexicon.

The second general component is comprehension, which, in fact, is not a single component at all, but a set of interrelated processes (of the kind referred to above) by which the reader builds a representation of the text meaning. According to the simple view of reading proposed by Gough and Tunmer (1986), reading equals decoding multiplied by comprehension. The second factor is regarded as composed of essentially the same processes as are involved in listening comprehension. Davey (1987) has also suggested that variables associated with decoding ability may be distinct from variables associated with reading comprehension.

In contrast to the view of reading as a very situation specific activity, we assume that there is some commonality in most reading situations which we would call "general reading ability" and which basically involves word recognition and comprehension.

However, we also recognize the operation of more text specific ability factors. For example, as has been argued by Bruner (1986) and others, narrative comprehension might involve a different type of thinking than what is involved in informative, argumentative comprehension. These two modes of thought, two modes of cognitive functioning, provide distinctive ways of ordering experience and of constructing reality.

Specific texts, for example a fairy tale, an explanation of how the age of a tree can be determined, or a brief document like a table or temperature diagram, also involve passage-specific demand characteristica including specific prior knowledge, specific inference requirements or specific spatial design conventions.

Thus, there is a reasonable basis for taking passage-specific factors into account in the decomposing of reading ability.

Even at the item level, the cognitive skills required to reach the correct answer choice might vary, being dependent on the type of questions asked or question-answer relation. Tal, Siegel, and Maraun (1994) distinguished between three separate task factors inherent in the assessment of reading comprehension. Passage independent questions can be answered with some accuracy even if the individual has not read the passage. Inference questions require the reader to interact with the text and provide a

missing link on the basis of the reader´s general knowledge of the facts presented in the text. Finally, locating questions simply require the reader to match the correct response alternative to a detail explicitly stated in the text An efficient look-back strategy at locating questions seems essentially to be more of a perceptual skill than a higher cognitive function.

Construction of the IEA tests

The construction of the IEA Reading Literacy Tests was an elaborate process which involved several steps (Elley, 1994). A large number of passages and questions were submitted by participating countries. About one thurd of the submitted passages was retained for full scale pilot testing after an initial screening. The pilot testing yielded data on which the final selection was based.

A simple three-domain classification of text types was applied - Narrative prose, Expository prose and Documents.

Narrative prose refers to continuous text materials in which the writer´s aim was to tell a story, whether fact or fiction. They are normally designed to entertain or involve the reader emotionally; they are written in the past tense, and usually have people or animals as their main theme.

Expository prose refers to continuous text materials designed to describe or explain something. The subjects of such texts are usually things, the style is typically impersonal, highlighting such features as definitions, causes, classifications, functions, contrasts and examples, rather than a moving plot with climax.

Documents refer to structured, tabular texts, such as forms, charts, labels, graphs, lists, and sets of instructions where the reading requirements typically involve locating information or following directions, rather than continuous reading of connected texts.

In the final selection for the IEA survey, the passages varied in length from short to moderate. The narrative texts for the 9-year-olds (the population in focus of this study) varied from 292 words to 706 words in the English version. The expository texts varied from 56 words to 383 words.

The documents were short displays of information in tabular formats, maps or graphs, fairly representative of the kind of documents one might expect students to meet in their environments

Table 1 presents the number of passages and items of the final test for 9-year-olds used for analyses in the present study.

Table 1

Rasch scaling was performed separately for each domain on the assumption that one dimension was sufficient to describe reading ability within each domain. The procedure postulates that an examinee's performance on a subtest can be explained by one latent trait or ability. As will be seen, this assumption is challenged in the decomposition approach taken in this study.

The ultimate goal in this paper is to find a proper estimate of classroom differences in achievement on which a basis would be established for the evaluation of teaching effects and other determinants of group differences such as home literacy and community resources. However, data on achievement is located at the student level, and variation at the individual student level obscures a true expression of classroom differences when aggregation to class means takes place. That is why HLM-procedures have become increasingly used in the analysis of data on different aggregation level (see, e.g., Raudenbusch & Bryk, 1987). The HLM methodology, however, takes its departure from manifest variables with measurement errors. The traditional intra-class correlation as a measure of between-class variability is also influenced by measurement error (Muthén, 1991).

The MFA approach

A multi-level factor analysis (MFA) provides estimates of the error-free proportions of between variance for each variable. Muthén (1991) has convincingly demonstrated that MFA can give reliable results using subscores based on very few items. This is important since it allows a

detailed specification, down to the item level, of aspects of reading achievement particularly vulnerable to instructional influences.

A "pure" estimate of variations of reading achievement at the classroom level makes it possible to localize factors or even test items displaying sufficient variations to deserve further explanations in terms of proximal teaching conditions. Hypotheses on specific teaching effects will be further strengthened if similar patterns appear in different countries.

In the specification of classroom variation in reading achievement, two basic requirements should be met:

(1) A good model of the structure of reading achievement at the level of individual students.

(2) A procedure for taking the individual variations in (1) into account when classroom differences are considered.

Decomposition steps

The total number of items in the test for 9-year-olds was 66. Structural modeling based on such large number of variables was almost impossible given the currently available computer power. In this study, we then restricted our focus to the 23 document items. However, we embedded the document items within a set of narrative och expository variables. For these domains we reduced the number of variables by forming item parcels of two or three items. Thus, for each of the 8 passages from the narrative and expository domains, two or three parcels of items were formed. Altogether, the MFA analysis was then based on 39 variables, of which 23 were document items and 16 narrative/expository item parcels. Balke (1995) based her decomposition of the IEA tests on all individual items. However, her analysis did not involve between factors.

The results to be presented here will demonstrate how a global skill like reading can be decomposed not only into individually based factors but also into factors related to group belongingness where differential influences of schooling conditions and home background could be discerned by reference to demand characteristics of small subsets of individual items.

Without going into the statistical estimation theory for multi-level factor analysis (see Muthén (1991), we note that the total covariance of the observed variables is decomposed or separated into one part referring to the

variation between school classes and one part referring to the variation between individuals within classes.

First, LISREL models were fitted separately for between and within levels. In the next step, the separate models were pieced together into one complete MFA model. This was done separately for each of the following seven countries: Sweden, Norway, Denmark, Germany (West), Ireland, Hong Kong and USA. The following principles guided the selection of countries. The data sets were known to be in good condition with a reasonably uniform administration of the test instruments and with a low error rate in the first data entry check at the IEA coordinating center for data processing in Hamburg. Secondly, the countries were, with one exception, not widely different in terms of economic development, language and culture. Yet, some differences in intraclass correlations were expected with small values in the Nordic countries and a higher degree of heterogeneity in Ireland, USA and Hong Kong.

Within model

At the student level (variation around class means) the modeling included the following decomposing steps according to the general ideas expressed in an earlier section. First, we assumed a general reading ability affecting all of the 39 variables (all three domains). The complex nature of this general factor is discussed by Balke (1995). As residual factors (when the general reading ability had been taken into account) we proposed two document factors - one requiting quite simple mental operations, like locating simple bits of information in tables, graphs or maps, and the other involving a higher mental load with working memory demands, where different pieces of information should be kept in mind for comparison or evaluation. Illustrative examples of this distinction among the document items are given in Figure 1.

Residual factors were also assumed in the narrative and expository domains. First, a number of passage factors were specified. Although the test was deliberately constructed to minimize the speed element of reading, it turned out that passages and items at the end of a test booklet had lower response rates in many countries. This could either be the result of difficulties in meeting the administrative time limit of the test due to slow reading speed or the result of lack of motivation and limited experience to

work with concentration over an extended period of time. In any case, it was reasonable to postulate a factor related to the end of booklets. This end factor did not operate on the document items, since they were located at earlier parts of the test.

Table 2 specifies the factors of the within-model with each of the 39 variables labeled in the rows. The 23 first are document items and the remaining italized variables are item parcels from narrative and expository passages.

Table 2

The within-structure with 9 factors were found in all countries except USA where no end-of-booklet factor could be identified. A possible reason for this negative finding in USA could be the general test habits developed among the students in a school system with frequent assessment.

Clearly, a general reading factor with significant loadings on almost all items or item parcels was identified in all countries supporting the hypothesis of reading ability as a general cognitive trait. The passage factor assumed for the text on dogs did not show up in a majority of countries. The end factor probably absorbed most of this passage.

The distinction between a more general document factor (doc) and a factor involving higher cognitive demands in dealing with document items (docm) is illustrated in the following example taken from the temperature passage.

Fig 1 in here

In the first item of the temperature passage, the main requirement is visual search. Once the highest temperature is located the answer is obvious for anyone knowing the spatial conventions of a table. However, the other

items involve a stronger cognitive load where more than one piece of information must be handled. In the bus passage, the cognitive load of item 3 is quite clear. The reader has to locate information, keep it mind and use it together with a calculation.

The main justification for doing a within analysis was to establish a basis for the two-level analysis where between variation and within variation is treated simultaneously. When the within-structure is taken into account one should not expect a between structure as rich as in the within case.

The between structure in MFA

Only one, two, or three factors could be identified at the between level at the MFA. Table 3 presents the between factors in each country studied.

Table 3

The general factor with loadings in all document items and the narrative and expository item parcels was identified at the between level in Sweden, Germany, Ireland, USA and Hong Kong. A more restricted document factor was found in Sweden, Germany and USA. No distinction of different kinds of document reading could be made at the between level.

As our main focus here is on documents, we can observe that neither Norway nor Denmark had any significant between factor related to documents (general or document), reflecting the homogeneous school systems in this respect. Thus, we cannot expect to find any significant signals of teaching effects on document reading in Norway and Denmark. However, the end factor was clearly significant in these countries which might indicate differential testing practices or classroom habits in dealing with longer texts. The absence of an end factor in Germany and Hong Kong is of minor concern here, since the end factor does not involve document items.

Before we look closer at the between results, the MFA model fit in the various countries should be presented. Table 4 gives Chi2 values together with three more telling goodness-of-fit indices: RMSEA, GFI, and NNFI

(Jöreskog & Sörbom, 1991). The number of classes and the number of students in each country are also specified.

Table 4

It is quite clear that the goodness of fit is excellent in all countries.

Although the variance explained by between factors is rather modest, in most cases below 10 percent, the picture becomes more telling when the variance explained by between factors is compared with the corresponding within variance.

Table 5 presents for each document item the percentage of variance explained by between factors in relation to the sum of the proportions of variance explained by between and within factors, (b/(b+w))x100. This coefficient is equivalent to a disattenuated intra-class correlation. Denmark and Norway could not be included in this analysis, since, as we have seen, no between factor related to documents could be identified in these countries.

Table 5

There were wide variation between countries as well as between items. Hong Kong and USA had both rather high values, whereas Germany(W) was at a surprisingly low level. There is no obvious interpretation of the extremely low German values. On the basis of intraclass correlations one would expect Sweden to show the lowest values. The high values in USA and Hong Kong are more congruent with their intraclass correlations and the general notion of more pronounced social stratification in these countries.

At the item level, there were also large differences. Items with consistently high values across countries were **buses 3**, **bottl 2**, **temp 2** and **temp 5**. One might, for example, suspect that some temperature items

require specific instructions to be solved, and that teaching practices in this respect varies a great deal.

Consistently low values were observed for **buses 1, buses 2, content 1** and **content 2.** Obviously, variation in performance on these items reflects indivually based skills rather than teaching variation.

There were also clear tendencies of item by country interactions. In Hong Kong and USA the highest value was obtained for **map 1** (59.3 and 50 percent, respectively). These values are indeed remarkably high, and this map item might be interpreted as particularly vulnerable to instructional influences in these countries. Map reading might thus be a target for instruction to a varying extent, which would create high between-class variation. In the other countries map reading is either a commonly taught skill or is a skill never explicitly taught.

The high values for **Maria´s time table** might reflect variation across classrooms with respect to the use of time tables for school work. Thus, the pattern of results seems to make some sense as interpreted post hoc. However, the design of the teacher questionnaire did not permit closer validations. It was not sufficiently detailed down at the item level to support the suggested interpretations.

What is more important is that the approach taken here with a decomposition of reading achievement at the item level in principle will permit a closer analysis of teaching effects and provide a chance of separating teaching effects from more general factors creating differences between classrooms, like, for example, community type or socio-exonomic level of the community where the school is located. Striking and invariant differences between items are not easily interpreted in socio-economic terms but rather invite educational interpretations. Although reading seems to a large extent be developed at arenas outside the formal school context, there might still be aspects of reading that are more influenced by teaching than other aspects. The MFA approach illustrated here might be the analytical tool to detect the teachable aspects of reading.

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Table 1. *Number of passages and items for 9-year-olds*

Domain	Number of passages	Number of items
Narrative	4	22
Expository	5	21
Document	6	23

Table 2. *The within model.*

VARIABLE	FACTOR									
	gen.	doc	docm	p1	p2	p3	p4	p5	p6	end
bottle1	x	x								
bottle2	x		x							
bottle3	x	x								
bottle4	x	x								
buses1	x	x								
buses2	x	x								
buses3	x		x							
buses4	x	x	x							
content1	x	x								
content2	x	x								
content3	x	x								
temp1	x	x								
temp2	x		x							
temp3	x		x							
temp4	x		x							
temp5	x		x							
map1	x									
map2	x	x								
map3	x		x							
map4	x									
maria1	x									
maria2	x									
maria3	x									
bird1	*x*									
bird2	*x*									
sand1	*x*							*x*		
sand2	*x*							*x*		
shark1	*x*								*x*	
shark2	*x*								*x*	
marm1	*x*									
marm2	*x*									
dogs1	*x*									*x*
dogs2	*x*									*x*
walr1	*x*				*x*					*x*
walr2	*x*				*x*					*x*
grandp1	*x*			*x*						
grandp2	*x*			*x*						*x*
tree1	*x*					*x*				*x*
tree2	*x*					*x*				*x*

italics indicate narrative and expository parcels. p1-p6 indicate passage factors

Table 3. *Between factors by country*

COUNTRY	FACTOR		
	General	Document	End
Sweden	x	x	x
Norway			x
Denmark			x
Germany (W)	x	x	
Irland	x		x
USA	x	x	
Hong Kong	x		

Table 4. *Model fit of the MFA analysis for each country.*

COUNTRY	no. classes	no. stud	df	Chi2	RMSEA	GFI	NNFI
Sweden	123	2 144	1338	3991	.030	.92	.91
Norway	191	2 296	1399	4165	.028	.93	.92
Denmark	164	2 556	1399	6669	.037	.88	.90
Germany(W)	150	2 596	1357	5272	.030	.92	.93
Ireland	122	2 592	1360	3201	.022	.96	.92
USA	164	3 440	1354	4310	.025	.95	.90
Hong Kong	167	3 146	1 368	3324	.021	.96	.91

Table 5. *Per cent variance explained by between factors in relation to the total amount of variance explained by both between and within factors*

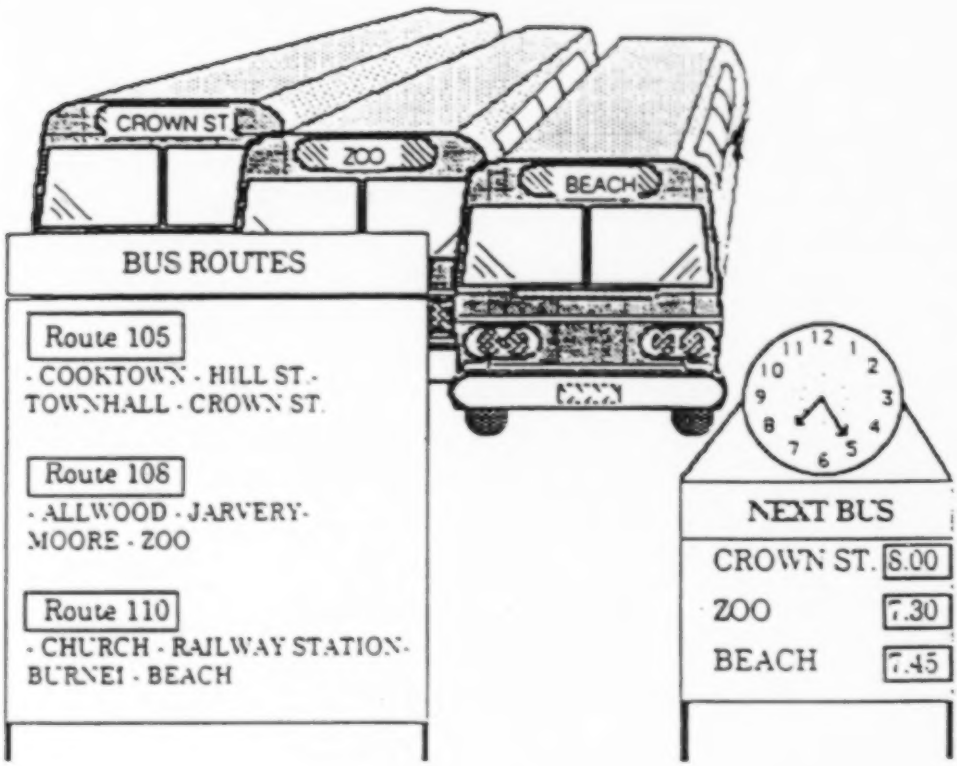
ITEM	COUNTRY				
	Sweden	Germany	Ireland	USA	Hong Kong
bottl 1	13.9	3.0	15.7	20.3	13.8
bottl 2	20.5	2.6	18.8	27.4	**31.0**
bottl 3	16.3	4.3	2.9	13.7	12.3
bottl 4	13.5	5.1	6.6	17.1	19.6
buses 1	6.6	2.4	16.1	12.5	12.9
buses 2	4.4	0.9	7.7	5.8	9.2
buses 3	28.5	6.6	28.0	29.5	**35.5**
buses 4	8.4	2.5	14.9	20.3	**32.0**
content 1	3.5	2.1	1.9	4.6	22.0
content 2	3.9	2.0	2.8	4.7	21.2
content 3	9.9	3.8	8.0	8.6	**31.4**
temp 1	8.2	3.4	12.4	27.4	**39.2**
temp 2	11.9	16.9	15.4	27.7	14.8
temp 3	5.8	4.7	9.3	21.4	21.8
temp 4	8.9	16.2	15.1	17.3	17.5
temp 5	7.5	6.7	25,3	**30.3**	**42,9**
map 1	9.9	0.3	10.7	**50.0**	**59.3**
map 2	10.5	1.4	4.1	**34.4**	**42.0**
map 3	10.4	2.4	17.8	**35.4**	**33.1**
map 4	11.1	0.8	11.6	**43.8**	**55.6**
maria 1	9.7	0.0	8.0	**31.0**	**53.2**
maria 2	13.2	2.6	14.1	**31.0**	**52.2**
maria 3	11.9	0.5	5.6	18.8	**53.5**
MEAN	10.8	4.0	11.9	23.0	31.6
SD	5.4	4.3	6.7	11.7	15.5

Values >30.0 are typed in bold face

FIGURE CAPTION

Figure 1. Two subtests from the document domain. The passage on bus time table includes the following items: *bus 1, bus 2, bus 3, bus 4,* The temperature passage includes: *temp 1, temp 2, temp 3, temp 4, temp 5.*

Buses



1. Anne wants to go to the railway station. Which route number should she choose?

   Route: _____

2. Where do you think the bus stops first on Anne's way to the railway station?

   _____

3. How long will it be before the next bus leaves for the zoo?

   _____

4. What is the name of the place where buses stop just before the zoo?

   _____

Temperature

The chart below shows some temperature readings made at different times on four days. Use the chart to answer the questions.

	6 a.m.	9 a.m.	12 Noon	3 p.m.	8 p.m.
Monday	15°C	17°C	20°C	21°C	19°C
Tuesday	15°C	15°C	15°C	10°C	9°C
Wednesday	8°C	10°C	14°C	13°C	15°C
Thursday	8°C	11°C	14°C	17°C	20°C

1. When was the highest temperature recorded?

A ___ Noon on Monday

B ___ 3 p.m. on Monday

C ___ Noon on Tuesday

D ___ Noon on Wednesday

2. On one day the temperature dropped quickly. When do you think this happened?

A ___ Monday morning

B ___ Tuesday afternoon

C ___ Wednesday afternoon

D ___ Thursday morning

3. On how many days was it colder at 8 p.m. than at 12 noon?

A ___ None
B ___ 1
C ___ 2
D ___ 3

4. On which day did the temperature go on rising steadily from 6 a.m. to 8 p.m.?

A ___ Monday
B ___ Tuesday
C ___ Wednesday
D ___ Thursday

5. Which of these thermometers shows the temperature at 6 a.m. on Wednesday?